PATENT SPECIFICATION

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COMPLETE SPECIFICATION

DRAWINGS ATTACHED

Means for Cooling or Warming Engine and/or Gear Oil

WE, KRAUSS - MAFFEI AKTIENGESELLSCHAFT, a German Body Corporate, of Munchen-Allach, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:—

This invention relates to a device for the cooling or heating of the engine and gear oil of vehicles with internal combustion engines and gears transmitting high powers, such as diesel locomatives, of the kind in which heat exchange takes place between a heatable cooling water circuit and the oil through heat exchangers. In the known arrangements the heat exchangers each consist of a container connected to the cooling water circuit of the internal combustion engine, within which container there is arranged a cooling coil connected by a pipe to the respective oil collection space. Each heat exchanger is here arranged outside the internal combustion engine or the transmission gear housing. For the circulation of the oil in this closed system formed by the pipe, the cooling coil, and the oil collection space there is provided an oil pump driven from the internal combustion engine as by being flanged on the gear housing. The cooling coil is washed in the container by the cooling water, which is then fed to the radiator for the dissipation of the heat given off by the oil, whence it flows back again into the heat exchanger. In order to achieve this circulatory flow a circulating pump is provided in the cooling water circuit. In order to prevent freezing of the cooling water at low external temperature, the cooling water circuit is provided with its own heating device or connected with a heating boiler which may be present on the locomotive. The circulating pump must here possess a drive independent of the internal combustion engine. In this case however it occurs that when the vehicle is stationary, for example during intervals in operation, as a result of the simultaneous halting of the oil pump or oil pumps, only the oil in the heat exchangers is kept warm, while the oil in the oil sump of the internal combustion engine or in the collecting spaces of the gearing cools down and thickens in the case of low external temperatures. On commencement of operation therefore, the necessary lubrication of the internal combustion engine and especially of the gearing is not reliably ensured. Furthermore, in the known arrangements relatively large quantities of oil and therefore correspondingly large oil pumps are necessary, so that together with the heat exchangers a relatively great technical expense, involving correspondingly high production and maintenance costs, is necessary. The space requirements and the power requirements, the latter especially in the case of starting up at low external temperatures, are very considerable.

It is an object of the invention so to improve the known arrangements that, with a simple construction requiring little space and power, reliable lubrication is ensured even at low external temperatures, without the cooling effect suffered in the case of high external temperatures.

According to the invention there is provided a device for cooling or heating the oil in the engine and in the change-speed transmission gear of an internal combustion engine driven vehicle, comprising two heat exchangers respectively located in the engine sump and the oil collecting space of the transmission gear housing and each being formed by a pipe connected in a water circuit, means operable to cool the water in said circuit during running of the engine,

[Price 4s. 6d.]

and means operable to heat said water while the engine is inoperative.

In such an arrangement separate heat exchangers in the vehicle are completely avoided. The oil pumps can be made relatively small, since they only have to deiver the small quantity of oil necessary for the lubrication over a short distance. The oil supply consists only of the quantity of oil in the engine sump or in the collecting space of the transmission gear, which can be brought to or maintained at the requisite temperature rapidly and reliably. This is also facilitated because it is possible to arrange that the oil shall wash round the heat exchangers conducting the cooling or heating water in a turbulent flow, so that maximum heat transfer is ensured. The range of viscosity of the optimum lubricating effect of the oil used can therefore be relatively small.

The invention is illustrated by way of example in the accompanying drawings, in which :—

Figure 1 shows diagrammatically an oil heating and cooling device for the transmission gearing of an internal combustion engine driven vehicle ;

Figure 2 is a fragmentary transverse vertical section, taken on line II-II of Figure 3, showing a heat exchanger located within a transmission gear housing ;

Figure 3 is a transverse horizontal section of Figure 2 ;

Figure 4 is a vertical longitudinal section taken on line IV-IV of Figure 3 ;

Figure 5 is a side elevation showing diagrammatically one of the bogies of a diesel locomotive in which the engine, transmission gear, distributor gear and wheel set driving gears are each fitted with oil heating and cooling devices ;

Figure 6 is a similar view to Figure 5 showing a modification and

Figure 7 is a diagrammatic side elevation showing the invention applied to an endless track vehicle.

In a diesel locomotive, for the maintenance of a predetermined oil temperature in the housing of the change speed transmission 1, which transmits high powers, a heat exchange device is provided. This device consists, in the arrangement shown in Figure 1, of a heat exchanger 2 for the gear oil, a radiator 3 and a heating boiler 4, of any desired construction, for the cooling water, as well as two circulating pumps 5 and 6 connectable alternately in the cooling water circuit. The transmission gear housing is provided in known manner with an oil collecting space 7 for the storage of the requisite quantity of oil and within which there is provided a coiled pipe forming the heat exchanger 2. On end of the coil 8 is connected to the radiator 3 arranged for example on a side wall or at an end of the locomotive, and over which cooling air is conducted by an adjustable speed fan 9. Furthermore, in the direction of flow of the cooling air there can be provided in front of the radiator 3 a radiator louvre 10 with adjustable air passage, so that the cooling air can be adapted, both as regards its quantity and its speed of flow, to any particular operating conditions. From the radiator 3 a conduit 11 leads to the heating boiler 4, which may be the boiler provided for the heating of the carriages of the train. The heating boiler 4 in turn is connected through conduits 12 and 13 to the other end of the cooling coil 8. In the conduit 13 there are provided two three-way valves or cocks 14 and 15, between which there are connected conduits 16 and 17 which can be connected according to choice into the conduit 13 by actuating the two three-way cocks 14 and 15. In order to achieve the requisite circulatory flow in the cooling water in each of these conduits 16 and 17 there is arranged a circulating pump 5, 6 respectively.

The heating boiler 4 consists, in the embodiment shown, of a water-filled, oil-heated container 18, through which there is conducted a cooling water pipe coil 19 connected to the conduits 11 and 12. Alternatively, the heating boiler 4 may be a boiler with or without forced feed, the stream from which is fed directly to the cooling water circuit. Through a by-pass conduit 22 arranged between the two conduits 11 and 12 and connected thereto by means of two three-way cocks 20 and 21, shutting off of the heating boiler 4 from the water circuit is rendered possible if heating of the water is not necessary. Of the two circulating pumps 5 and 6, preferably rotary pumps, the pump 5 is driven directly by the diesel engine while the other pump 6 is connected to a direct current motor 23, for which there serves as the current source the battery of the diesel locomotive. Under normal travelling conditions the circulation pump 5 driven by the diesel engine is connected into the cooling water circuit, while the pump 6 is stationary. If, however, maintenance of the predetermined oil temperature is desired with the diesel engine stationary, the two three-way cocks 14 and 15 provided in the conduit 13 are switched over and the other circulating pump 6 driven by the direct current motor 23 is then set in operation. The means for setting in operation and switching off the electrically driven circulating pump 6 may be coupled with the means for changing over of the two three-way cocks 15 and 15, in order to simplify the operation. If the electrically driven circulating pump 6 is constantly switched on, the two three-way cocks 14 and 15 and the circulating pump 5 of the diesel engine can

be omitted, so that the arrangement is substantially simplified. The continuous operation of the pump 6 ensures, when the vehicle is out of operation, that the entire quantity of oil in the oil collecting space 7 will be kept warm and thus constantly ensure the full lubrication capacity of the oil even in the case of great cooling of the diesel locomotive, as can occur for example in the case of the vehicle standing in the open for a long time.

Where the arrangement according to Figure 1 is used for the cooling of the transmission gear oil, the cooling water circuit comprises the cooling coil 8 in the oil collection space 7, the radiator 3, the by-pass conduit 22 and whichever circulating pump 5 or 6 is switched on. The heating boiler 4 is here disconnected from the water circuit. By appropriate setting of the speed of rotation of the fan 9 and of the air passage of the radiator louvre 10 the cooling water temperature can be so adjusted that the oil in the oil collecting space 7 of the gear 1 is cooled to the predescribed temperature. If, however, heating of the gear oil is necessary, the heating boiler 4 is connected into the cooling water circuit in place of the by-pass 22 by switching over of the two three-way cocks 20 and 21. Furthermore, by arresting the fan 9 and closing the air passage of the radiator louvre 10 cooling of the cooling water in the radiator 3 is suppressed. Switching over of the cooling water circuit from "cooling" to "heating" or vice-versa by connection or disconnection of the by-pass conduit 22 can be effected by hand by shifting over of the three-way cocks 20 and 21, but it is readily possible to provide, for example in the oil collection space 7, a thermostat by which an automatic switching over is effected when the oil temperature drops below or exceeds a desired value.

Figures 2, 3 and 4 show a constructional form of heat exchanger located, as in Figure 1, within the oil collecting space in a transmission gear housing 24. As shown, the housing 24 is formed in the region of its oil collection space 7 for the lubricating oil with an internally recessed arcuate cover 25. The cover has an external flange 26 on its inner edge of the housing 24 around the opening is formed with an internal flange 27 which serves for the reception of screws 28 by which the cover 25 is secured to the housing 24. Approximately in the region of each of the centres of curvature of the two semi-circular ends of the cover 25 cross-section of the lid there is provided a pipe passing through the end wall of the cover and extending into the oil collecting space 7. One of these two pipes is designated hereinafter as the water inlet pipe 29, the other as the water outlet pipe 30. The ends of these two pipes within the oid collecting space 7 are closed for example by welded-on cover plates 31, closure plugs or the like. Connected between the pipes there is provided in the oil collecting space 7 a coiled pipe arrangement serving for the heat exchange, which arrangement consists, in the embodiment illustrated, of two looped pipes 32 arranged in parallel. These looped pipes 32, each having two and a half turns, are adapted in their form to the arcuate shape of the cover 25 and the opening of the gear housing 24.

Oil for force-feed lubricating purposes is withdrawn from the oil collecting space 7 by a suction pipe 34 extending through the end wall 33 of the housing 24 opposite the cover 25, said pipe 34 being disposed parallel to the water inlet and outlet pipes 29, 30 and passing through the loops of the pipes 32 to adjacent the end wall of the cover 25. The inner end of the suction pipe 34 is closed by a closure plug 35, a cover plate or the like. This suction pipe 34, is connected to the suction side of an oil pump (not shown) arranged outside the housing 24. In order to enable the oil in the space 7 to enter suction pipe 34, the latter is formed with axially extending slots 34 which, in order to keep coarser impurities in the oil away from the oil pump, are covered by a close-meshed net 37 surrounding the suction pipe 34. Approximately symmetrically of the cover relative to the suction pipe 34 is an oil return pipe 38 leading from the oil pump, said pipe 38 extending a short distance into the oil collecting space 7 and being provided with an overflow valve 39 through which oil not required for lubrication of the individual lubrication points of the transmission gear 1 is returned direct into the oil collection space 7. Thus, in the region of the looped heat exchange pipes 33 a turbulent flow of the oil in the oil collection space 7 takes place, which oil is given an additional turbulence due to the oil flowing from the lubrication points into the oil collection space 7. An intensive heat exchange consequently takes place between the gear oil and the cooling water.

The diesel locomotive shown in Figure 5 is provided with bogies (only one of which is shown) each having three driving wheel sets driven by hydraulic power transmission from the engine 40 through transmission gear 41, distributor gear 42, and individual wheel set gears 43. The engine sump and the oil collecting spaces in the housings of gears 41, 42 and 43 each contain a heat exchanger pipe arrangement 44 which are similar to that shown in Figures 2 to 4. The radiator 45 is here cooled by a fan 46 driven directly by the diesel engine 40. In place of the direct drive of the fan 46 however, any other desired drive can be provided. All the heat exchangers 44 are connected in series

with one another and may be connected through a single circulating pump (not shown) independent of the diesel engine 40 to the radiator 45. Alternatively, if the engine drives a water circulating pump 47, the independently driven pump must also be provided as shown in Figure 1. The connection of the heating boiler in the water circuit is also similar to that shown in Figure 1.

However, it is not necessary to connect all the heat exchangers 44 in series. In the modification shown in Figure 6, which is provided, like the preceding embodiment on a bogey diesel locomotive, with hydraulic power transmission, but with only two driving wheel sets, the heat exchangers 44 in the sump of the diesel engine 40 and the oil collecting space of the gear 41 are connected in series, as are also those in the oil collecting spaces of the distributor gear 42 and the two axle gears 43. The two groups of series connected heat exchangers are connected in parallel to the cooling water circuit, that is to say to the radiator 45 and the circulating pump or pumps 47. The heating boiler (not shown) is connected as in Figure 1 to the cooling water cycle.

As a further alternative and as shown in Figure 7, all the heat exchangers can be connected in parallel to the common inlet and outlet pipes 48, 49. As may be seen from this Figure the device of the invention is not limited to incorporation in rail vehicles. It can equally well be employed in road and endless track vehicles, in the case of the example for the engine 50, the change-speed transmission gear 51 and the steering gear 52 of an endless track vehicle. Any desired conventional heater (not shown) may be employed, being connected as shown in Figure 1.

WHAT WE CLAIM IS:—

1. A device for cooling or heating the oil in the engine and in the change-speed transmission gear of an internal combustion engine driven vehicle, comprising two heat exchangers respectively located in the engine sump and the oil collecting space of the transmission gear housing and each being formed by a pipe connected in a water circuit, means operable to cool the water in said circuit during running of the engine, and means operable to heat said water while the engine is inoperative.

2. A device as claimed in claim 1, wherein the water circuit includes an air-cooled radiator and a heater, the heater being continuously operative.

3. A device as claimed in claim 2, wherein the water circuit includes a circulating pump continuously driven independently of the engine.

4. A device as claimed in claim 1, wherein the water circuit includes an air-cooled radiator, a heater and valve means by which the heater can be disconnected from said circuit while the engine is running.

5. A device as claimed in claim 4, wherein the water circuit includes two circulating pumps one of which is driven by the engine and the other independently thereof, and valve means to open either pump to the water circuit and close the other pump.

6. A device as claimed in any one of the preceding claims, wherein each heat exchanger comprises at least one looped pipe.

7. A device as claimed in any one of the preceding claims, wherein a pair of pipes communicating with the engine sump and another pair of pipes communicating with the oil collecting space in the transmission gear housing are provided for circulating the oil through suction oil pumps to lubricate points, each suction pipe extending through the respective coiled pipe heat exchanger and being formed in the region of said heat exchanger with axially extending slots, and the other pipe of each pair being fitted with a valve through which excess oil is returned to the engine sump or gear housing.

8. A device as claimed in any one of the preceding claims, wherein the heat exchangers are connected in series in the water circuit.

9. A device as claimed in any one of claims 1 to 7, wherein the heat exchangers are connected in parallel in the water circuit.

10. A device as claimed in any one of the preceding claims installed in an internal combustion engine driven bogie locomotive having a distributor gear driven from the change speed transmission gear and bogie wheel set driving gears driven from said distributor gear, wherein additional heat exchangers connected in the water circuit are located in the housings of the distributor and wheelset driving gears.

11. A device as claimed in any one of claims 1 to 9 installed in an internal combustion engine driven endless track vehicle, wherein an additional heat exchanger connected in the water circuit is located in the vehicle steering gear housing.

12. A device as claimed in claim 1 substantially as hereinbefore described with reference to any of the embodiments illustrated in the accompanying drawings.

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FIG.1.

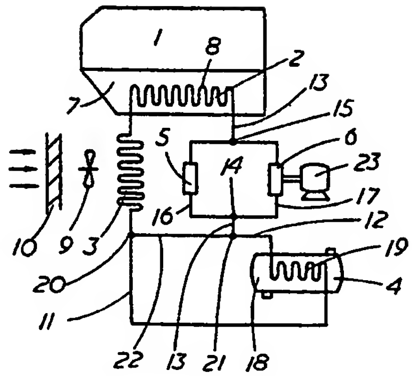


FIG.4.

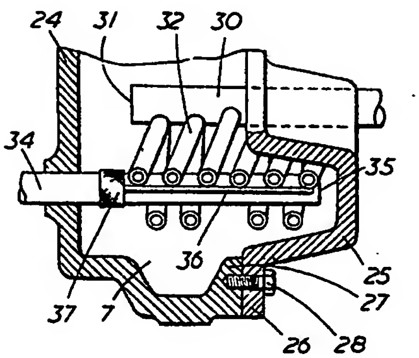


FIG.2.

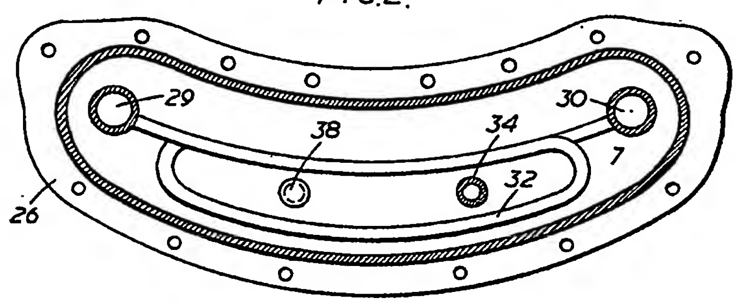
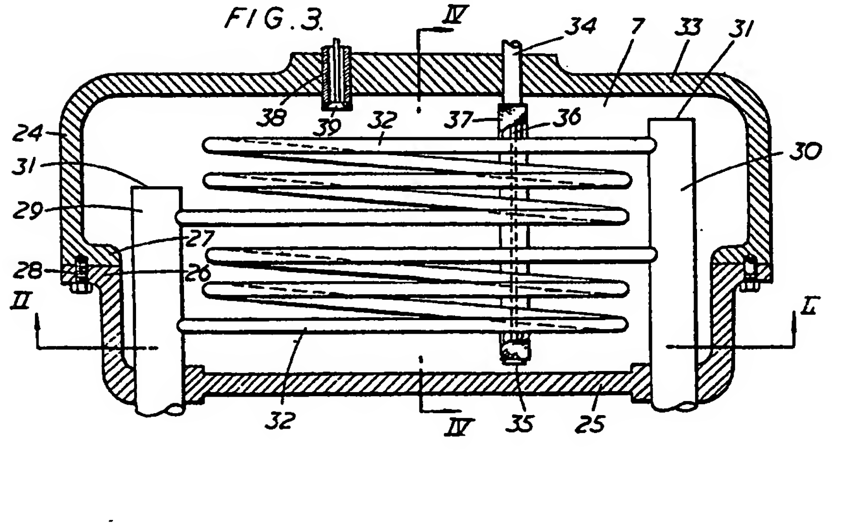


FIG.3.



920,614 COMPLETE SPECIFICATION
2 SHEETS

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SHEETS 1 & 2

FIG.5.

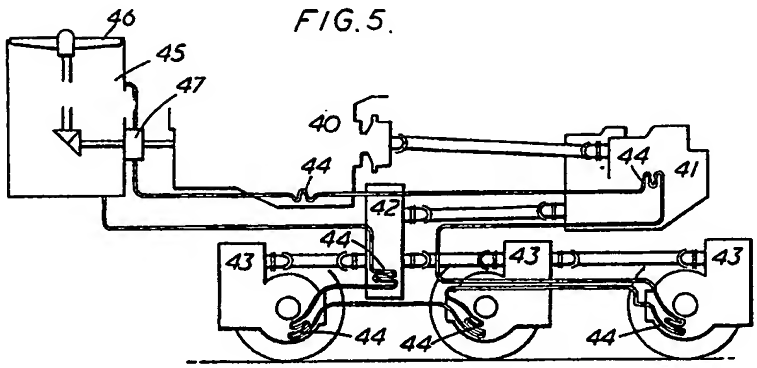


FIG.7.

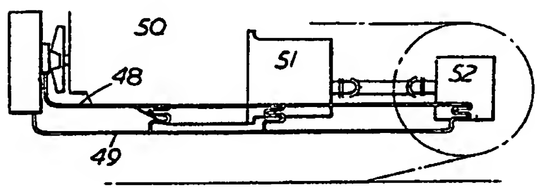
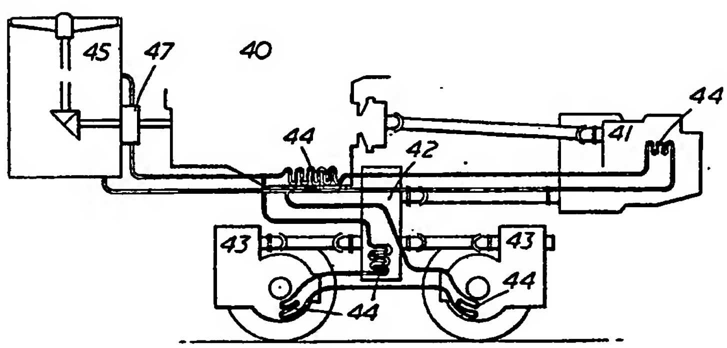


FIG.6.



920,614 COMPLETE SPECIFICATION
2 SHEETS
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SHEETS 1 & 2

FIG.1.

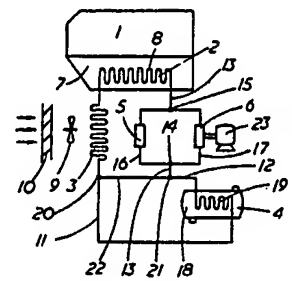

FIG.4.

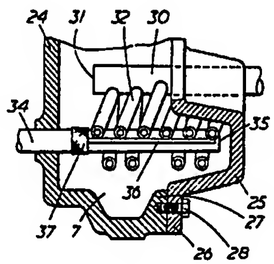

FIG.2.

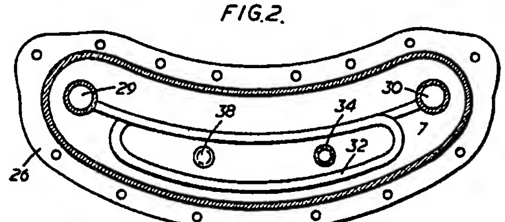

FIG.3.

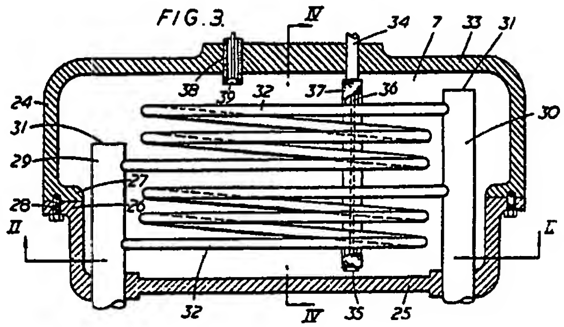

FIG.5.

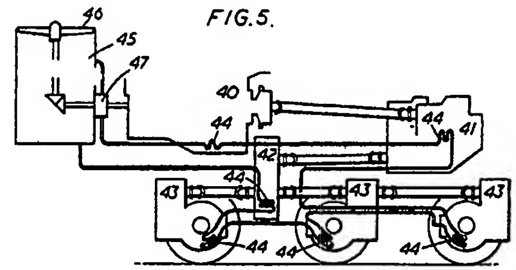

FIG.7.

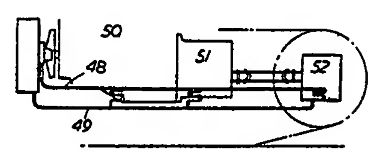

FIG.6.